

(Modified) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371**

PD990054

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR

10/031582

INTERNATIONAL APPLICATION NO.

PCT/EP00/06476

INTERNATIONAL FILING DATE

07 JULY 2000 (07.07.00)

PRIORITY DATE CLAIMED

19 JULY 1999 (19.07.99)

TITLE OF INVENTION

ELECTRICAL INSULATION DEVICE WITH OPTOCOUPLER FOR BIDIRECTIONAL CONNECTING LINES

APPLICANT(S) FOR DO/EO/US

Klaus Gaedke and Herbert Schutze

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☐ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
 - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
 - a. ☒ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☒ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Return Postcard Receipt

EXPRESS MAIL NO: EL 722193412 US DATE OF DEPOSIT: JANUARY 18, 2002

APPLICATION NO. (IF KNOWN, SEE 37 CFR

10/031582

INTERNATIONAL APPLICATION NO.

PCT/EP00/06476

ATTORNEY'S DOCKET NUMBER

PD990054

The following fees are submitted:

CALCULATIONS PTO USE ONLY

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

- ☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO \$1040.00
- ☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO \$890.00
- ☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$740.00
- ☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$710.00
- ☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =

\$890.00

Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 CFR 1.492 (e)).

☐ 20 ☐ 30

\$0.00

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE
Total claims	5 - 20 =	0	x \$18.00
Independent claims	1 - 3 =	0	x \$84.00

\$0.00

\$0.00

Multiple Dependent Claims (check if applicable).

☐

\$0.00

TOTAL OF ABOVE CALCULATIONS =

\$890.00

☐ Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.

\$0.00

SUBTOTAL =

\$890.00

Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 CFR 1.492 (f)).

☐ 20 ☐ 30

+

\$0.00

TOTAL NATIONAL FEE =

\$890.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) (check if applicable).

☒

\$40.00

TOTAL FEES ENCLOSED =

\$930.00

Amount to be:
refunded

\$

charged

\$

- a. ☐ A check in the amount of _____ to cover the above fees is enclosed.
- b. ☒ Please charge my Deposit Account No. 07-0832 in the amount of \$930.00 to cover the above fees. A duplicate copy of this sheet is enclosed.
- c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 07-0832. A duplicate copy of this sheet is enclosed.
- d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Mr. Joseph S. Tripoli
THOMSON multimedia Licensing Inc.
Patent Department
PO Box 5312
Princeton, New Jersey 08540

SIGNATURE

Jeffrey M. Navon

NAME

32,711

REGISTRATION NUMBER

January 18, 2002

DATE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Klaus Gaedke et al.

Filed : July 7, 2000 - PCT National Phase of PCT/EP00/06476

For : ELECTRICAL INSULATION DEVICE WITH OPTOCOUPLER
FOR BIDIRECTIONAL CONNECTING LINES

PRELIMINARY AMENDMENT

Hon. Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Sir:

In the US national phase application of PCT/EP00/06476
please enter the following amendments.

IN THE SPECIFICATION:

Please amend the specification as follows:

Page 1, After the title, insert the following paragraph:

--This application claims the benefit under 35 U.S.C. § 365 of
International Application PCT/EP00/06476, filed July 7, 2000, which claims
the benefit of German Application No. 19933135.9, filed July 19, 1999.—

IN THE CLAIMS (As published in the International Preliminary Examination
Report):

Please amend the claims as follows. This is the clean version.
Attached is the marked up version of these claims.

What is claimed is:

1. (Amended) Electrical insulation device for a bidirectional
connecting line, that connects two electronic circuit units to one another,
said electrical insulation unit being located anywhere along the connecting

line and comprises at least one optocoupler providing electrical insulation, wherein, either one single optocoupler or two separate optocouplers are provided for the bidirectional connecting line, and in that a control unit is provided, which generates switching signals, which switching signals either change over the effective direction of the single optocoupler with regard to the associated connecting line or which switching signals activate one of the two optocouplers and deactivate the other optocoupler, for transmission of signals via the associated connecting line in a direction opposite to the previous signal flow direction.

2. (Amended) Electrical insulation device according to Claim 1, the bidirectional connecting line relating either to a data line or a control line.
3. (Amended) Electrical insulation device according to claim 1, the circuit units which are connected to one another via the connecting line relating to the circuit blocks, data link layer block and physical layer block of a connection interface, in particular IEEE 1394 bus interface.
4. (Amended) Electrical insulation device according to Claim 3, the respective control unit evaluating the control signals on two control lines of the connecting bus between data link layer block and physical layer block in accordance with the IEEE 1394 Standard.
5. (Amended) Electrical insulation device according to Claim 1, tristate drivers, which are switched into corresponding states by the control unit, being used for changing over between the optocouplers or for changing over the effective direction of one optocoupler.

IN THE ABSTRACT:

Page 13 Please add the Abstract supplied on a separate sheet herewith.

REMARKS

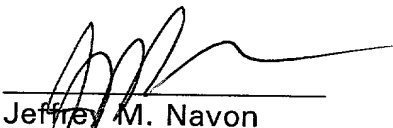
The specification has been amended to include a reference to the priority applications.

The above amendments to the claims have been made to eliminate reference indicia and to meet the requirements of the USPTO. A marked up version is supplied on a separate sheet.

An Abstract is supplied on a separate sheet.

No fee is believed to have been incurred by virtue of this amendment. However, if a fee is incurred on the basis of this amendment, please charge such fee against deposit account 07-0832.

Respectfully submitted,
Klaus Gaedke et al.



Jeffrey M. Navon
Registration No. 32,711
609/734-9400

THOMSON multimedia Licensing Inc.
Patent Operation
PO Box 5312
Princeton, NJ 08543-5312

Date: January 18, 2002

Marked Up Claims

What is claimed is:

- 5 1. (Amended) Electrical insulation device for a bidirectional
connecting line [(CTL[0:1], D[0:7])], that connects two
electronic circuit units [(10, 20)] to one another, said
electrical insulation unit [(30)] being located anywhere along
the connecting line [(CTL[0:1], D[0:7])] and comprises at least
10 one optocoupler providing electrical insulation, [**characterized
in that**] wherein, either one single optocoupler or two separate
optocouplers [(311, 312)] are provided for the bidirectional
connecting line [(CTL[0:1], D[0:7])], and in that a control
unit [(33)] is provided, which generates switching signals
15 [(EN, \overline{EN})], which switching signals [(EN, \overline{EN})] either change
over the effective direction of the single optocoupler with
regard to the associated connecting line [(CTL[0:1], D[0:7])],
or which switching signals activate one of the two optocouplers
[(311, 312)] and deactivate the other optocoupler, for
20 transmission of signals via the associated connecting line
[(CTL[0:1], D[0:7])] in a direction opposite to the previous
signal flow direction.
2. (Amended) Electrical insulation device according to Claim
25 1, the bidirectional connecting line [(CTL[0:1], D[0:7])] relating either to a data line [(D[0:7])] or a control line [(CTL[0:1])].
3. (Amended) Electrical insulation device according to claim
30 1 [or 2], the circuit units [(10, 20)] which are connected to
one another via the connecting line relating to the circuit
blocks, data link layer block [(10)] and physical layer block
[(20)] of a connection interface, in particular IEEE 1394 bus
interface.
- 35 4. (Amended) Electrical insulation device according to Claim
3, the respective control unit [(33)] evaluating the control
signals on two control lines [(CTL[0:1])] of the connecting bus

between data link layer block [(10)] and physical layer block [(20)] in accordance with the IEEE 1394 Standard.

5. (Amended) Electrical insulation device according to [one
5 of Claims 1 to 4] Claim 1, tristate drivers [(32)], which are
switched into corresponding states by the control unit [(33)],
being used for changing over between the optocouplers or for
changing over the effective direction of one optocoupler.

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Abstract

An electrical insulation device for bidirectional connecting lines is proposed which operates reliably at high frequencies and can be integrated easily on a chip. In accordance with a first embodiment, for the purpose of electrical isolation, two separate optocouplers are provided per bidirectional connecting line. A control unit evaluates the control signals which are output by one of the two circuit units, and thereupon activates one of the two optocouplers while the other optocoupler is simultaneously deactivated, in order, in this way, to allow transmission of signals via the associated connecting line in one direction. In a second embodiment of the invention, only a single optocoupler is provided per bidirectional connecting line. The control unit is provided in this solution as well, except that in this case it changes over the effective direction of the optocoupler by means of corresponding circuit components, thereby once again achieving transmission of signals via the associated connecting line in one direction.

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Electrical insulation device with optocoupler for
bidirectional connecting lines

The invention relates to an electrical insulation
5 device for bidirectional connecting lines/bus lines with
the use of optocouplers.

Prior Art

The invention is based on an electrical
10 insulation device for bidirectional connecting lines of
the generic type of the independent Claims 1 and 2. If a
plurality of independent apparatuses are interconnected
via lines, then it is often necessary to provide
electrical insulation between the interconnected
15 components. This applies particularly whenever the
connected apparatuses are installed e.g. in a manner
distributed in a building. This is because in this
situation relatively large potential differences between
the apparatuses can occur, which are caused e.g. by
20 different potentials on the power supply lines. Such
potential differences may occur in the range from a few
millivolts up to a number of volts. Potential differences
of this type may be present with greater or lesser
stability. They may vary e.g. in accordance with the
25 instantaneous total power consumption in the building.
However, they may also fail momentarily, with destructive
effect, e.g. due to a lightning strike in the building
itself or in the vicinity of the building.

In the less severe case, the data signals and/or
30 control signals which run via the bus connections are
merely corrupted. However, they can lead to the
destruction of the connected circuit sections.

The problem of undesirable earth loops, caused by
the connecting lines, frequently arises. By way of
35 example, induced current can flow through the cable
screen of the bus connection and likewise corrupt the
transmitted data signals. If the induced potential
difference is large enough, persons who happen to be

handling the corresponding bus connection cable could also be injured.

Therefore, the requirement for complete electrical isolation of the stations which are connected to one another by lines is necessary.

One example of a bus system in which electrical isolation of the components which are connected to one another is required is the IEEE 1394 bus standard, which has recently acquired increasing importance. The exact designation of this bus standard reads as follows: IEEE Std 1394-1995, "IEEE Standard for a high performance serial bus" of 12.12.1995.

What is involved is a bus system containing two data line pairs and also two power supply lines earth and V_{cc} and also a cable screen in the bus connection cable. The two data line pairs allow synchronous serial data transmission. What is probably one of the most outstanding properties of the bus system is that data transmission is possible at very high data rates of 100 megabits per second up to 400 megabits per second.

With regard to the realization of electrical isolation of stations which are connected to one another via the bus, two explicit circuit realizations are specified in Appendix J.6 of the abovementioned standard. In both cases, electrical isolation is performed between the data link layer module and the physical layer module. A transformer connected up appropriately with resistors and capacitors is used for the electrical isolation in one case, and capacitive decoupling is provided for the electrical isolation in the other case. These solutions have assumed, however, that the data link layer module and the physical layer module are present as separate chips. It has been shown in retrospect that the capacitive isolation of the two modules does not constitute a reliable solution in practice at the high frequencies. Instances of signal corruption and interfering irradiation have occurred. In the case of electrical insulation using a transformer, moreover,

there is the disadvantage that this solution can no longer be used if the data link layer module and the physical layer module of the bus interface are intended to be integrated on a single chip.

5 Furthermore, it is known to use so-called optocouplers for the electrical isolation of circuit units which are connected to one another.

Invention

10 The object of the invention is to specify an electrical insulation device in particular for bidirectional connecting lines which operates reliably even at very high frequencies and can be integrated very easily on a chip.

15 The object is achieved by means of the features of the independent Claims 1 and 2. In accordance with a first embodiment of the invention, the electrical insulation device for bidirectional connecting lines comprises two separate optocouplers per bidirectional
20 connecting line and a control unit, which generates switching signals in a manner dependent on control signals output by one of the two circuit units, which switching signals, via corresponding switches, activate one of the two optocouplers and deactivate the other
25 optocoupler, and thus allow transmission of signals via the connecting line in one direction. This solution does not require poorly integrable components such as transformers. Moreover, the aforementioned control unit can be constructed in a simple manner and can be readily
30 integrated on a chip.

The second solution according to the invention in accordance with Claim 2 manages with just one optocoupler per bidirectional connecting line. This is achieved by modifying the control unit in such a way that, in a
35 manner dependent on the control signals output by one of the two circuit units which are connected to one another, the said control unit changes over the effective direction of the optocoupler with regard to the

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associated connecting line. In this case, it is necessary merely to provide two more switches for the switching operations. The implementation of such switches does not constitute a problem for the chip design. Therefore, this
5 solution provides an electrical insulation device which can be integrated in a particularly simple manner.

Further advantageous developments and improvements of the devices mentioned in Claims 1 and 2 are possible by virtue of the measures evinced in the
10 dependent claims. In accordance with Claim 4, the electrical insulation device may very advantageously be provided between a data link layer module and a physical layer module of a bus interface. If the solution is used in the case of an IEEE 1394 bus interface, then it
15 suffices for the respective control unit to evaluate the control signals on the two control lines CTL [0:1] of the connecting bus between the two modules in order to activate the corresponding optocoupler or to change over the effective direction of the optocoupler.

20 Tristate drivers, in particular, may expediently be used as switches for the changeover between the optocouplers or for changing over the effective direction of the optocoupler, the said tristate drivers being driven correspondingly by the control unit.

Drawings

The exemplary embodiments of the invention are illustrated in the drawings and are explained in more detail in the description below. In the figures:

5

Figure 1 shows the connecting lines between the data link module and the physical layer module in accordance with the IEEE 1394 standard;

10

Figure 2 shows the basic arrangement of the data link layer module, the electrical insulation device and the physical layer module;

Figure 3 shows the structure of the electrical insulation device in accordance with a first exemplary embodiment of the invention;

15

Figure 4 shows a state diagram of the control unit of the electrical insulation device as shown in Figure 3;

20

Figure 5 shows the structure of the electrical insulation device in accordance with a second exemplary embodiment of the invention.

Exemplary Embodiments of the Invention

The invention is explained using the example of an electrical insulation device for an IEEE 1394 bus interface. Figure 1 shows the basic structure of an IEEE 1394 bus interface. The latter comprises the two modules data link layer module 10 and physical layer module 20. These two modules may be integrated on separate chips. It is desirable, however, for these modules to be integrated together on a single chip. The connection between the modules is effected by two bidirectional control lines CTL[0:1], and e.g. eight bidirectional data lines D[0:7], and also a unidirectional control line LREQ proceeding from the data link layer module, and also a control line SCLK for the system clock, proceeding from the physical layer module. For the sake of clarity, it is also mentioned that the connection to a further IEEE 1394 bus interface is effected via external connecting lines which

are not illustrated and are connected to the physical layer module 20. Accordingly, the data link layer module 10 contains connections which connect the IEEE 1394 bus interface to an application unit. For further details
5 regarding the structure and the method of operation of the modules data link layer module and physical layer module, reference is made to the IEEE 1394 standard already mentioned above.

In accordance with a proposal in the IEEE 1394
10 standard, the electrical insulation device 30 is provided between the data link layer module 10 and the physical layer module 20. This is illustrated in Figure 2.

The structure of the electrical insulation device 30 is represented for a first exemplary embodiment in
15 Figure 3, in which an optocoupler unit is designated by the reference numeral 31. This unit contains two separate optocouplers 311, 312. The latter are reverse-connected in parallel, so that the light-emitting element of one optocoupler is connected to that part of the
20 bidirectional connecting line which is connected to the data link layer module 10, and the light-emitting element of the other optocoupler is fed by that part of the connecting line which is connected to the physical layer module. In the example shown, the control line CTL[0] is
25 connected to the optocoupler unit 31. Between the two optocouplers, a respective tristate driver 32 is connected on each side of the optocoupler unit 31. The two tristate drivers 32 illustrated are switched by complementary enable signals \overline{EN} and EN. This will be
30 discussed in more detail below. The tristate drivers 32 have the following effect. They can be switched either into a high-impedance state or into a low-impedance state in which they allow signals to pass. If we suppose that the tristate driver 32 on the side of the data link layer
35 module 10 is switched in a low-impedance manner, a signal flow is possible via the control line CTL[0] proceeding from the physical layer module 20 via the lower optocoupler 312 to the data link layer module 10. The

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reverse signal flow is simultaneously inhibited, since the tristate driver 32 on the side of the physical layer module 20 is simultaneously switched in a high-impedance manner. In parallel with this, it is also possible, of course, to effect a switch-off of the upper optocoupler at the same time. In the reverse case, that is to say if the left-hand tristate driver 32 is switched in a high-impedance manner and the right-hand tristate driver 32 is switched in a low-impedance manner, a signal flow is possible from the data link layer module 10 to the physical layer module 20 via the control line CTL[0]. The changeover of the tristate drivers 32 is effected with the aid of the control signals EN and \overline{EN} by the control unit 33. To that end, the control unit 33 evaluates the signal states on the two control lines CTL[0:1]. For complete functioning, the clock signal SCLK or a clock signal modified therefrom and also a reset signal are additionally fed to the control unit 33.

The IEEE 1394 standard provides for the physical layer module 20 to have control over the bidirectional connecting lines CTL[0:1] and D[0:7]. The data link layer module 10 is permitted to drive these bidirectional connecting lines only when the physical layer module 20 relinquishes its control over these lines to the data link layer module 10. A full explanation of when and how the physical layer module 20 relinquishes its control over the bidirectional connecting lines can be found in Appendix J of the IEEE 1394 standard. A state diagram for the control unit 33, which fulfils the specifications of the IEEE 1394 standard, is shown in Figure 4 and is explained in more detail below.

Before that explanation, it is also pointed out that the structure shown in Figure 3 with the tristate drivers 32 and the optocoupler arrangement 31 must be present for each of the bidirectional connecting lines between data link layer module 10 and physical layer module 20, that is to say for the control lines CTL[0:1] and the data lines D[0:7]. For the two unidirectional

control lines LREQ and SCLK, simple optocouplers must be present in a complete electrical insulation device, which optocouplers, however, only have to act in one direction in accordance with the unidirectionality of these lines.

5 That state diagram of the control unit 33 shows 4 states. After a reset or after the initialization of the bus interface, the control unit 33 is put into the state IDLE. In this state, the control unit outputs the logic states $EN=0$ and $\overline{EN}=1$ as output signals. This is
10 equivalent to the changeover of the left-hand tristate driver 32 of Figure 3 into the low-impedance state and the changeover of the right-hand tristate driver 32 into the high-impedance state. The signal flow via all the bidirectional lines therefore proceeds from the physical
15 layer module 20 to the data link layer module 10. This state is left if the logic level 1 has been detected in a clock cycle on both control lines CTL[0] and CTL[1]. The control unit 33 is then put into the state CHECK0. It then awaits the state of the two control lines in the
20 next clock cycle. If both control lines have the state logic 0, the control unit 33 is put into the state LINK. In all other cases, the control unit 33 returns to the IDLE state. In the LINK state, the combination $EN=1$ and $\overline{EN}=0$ is output as output signal. This is equivalent to
25 the relinquishing of control over the bidirectional connecting lines to the data link layer module 10. Consequently, the left-hand tristate driver 32 of Figure 3 is then put into the high-impedance state and the right-hand tristate driver 32 is switched to the
30 low-impedance state. Thus, the signal flow for all the bidirectional lines then proceeds from the data link layer module 10 to the physical layer module 20. If, in this state, the logic 0 state arises on both control lines CTL[0:1], then the control unit 33 leaves the LINK
35 state and changes over to the CHECK1 state. In this state, a check is made to determine whether the logic state 0 is likewise supplied via both control lines in the subsequent clock cycle. If this is the case, the

control unit 33 changes back to the IDLE state. Otherwise, it changes over to the LINK state.

The alternative embodiment of an electrical isolation device according to the invention will now be explained in more detail with reference to Figure 5. Similar components are designated by the same reference symbols as in Figure 3. The difference from the solution as shown in Figure 3 consists in the fact that, in the optocoupler unit 31, only one optocoupler is provided per bidirectional connecting line. However, the effective direction of the said optocoupler is changed over in a manner dependent on the signals on the control lines CTL[0:1]. This is effected by 4 tristate drivers 32 per connecting line. In this case, the control unit 33 is constructed in exactly the same way as in the example of Figure 3. It functions according to the same state diagram as illustrated in Figure 4. Thus, in the IDLE state, it will output the logic states 0 and 1 via the lines EN and \overline{EN} . As a result, the first of the two tristate drivers 32 on the left-hand side of Figure 5 is switched in a high-impedance manner and the second tristate driver is accordingly switched in a low-impedance manner. Accordingly, the first of the two tristate drivers on the right-hand side of Figure 5 is likewise switched in a high-impedance manner and the other in a low-impedance manner. The signal flow is then as follows. The signal flows via the data line D[0] proceeding from the physical layer module 20 as transmitter to the second tristate driver 32 on the left-hand side of Figure 5 via the optocoupler to the second tristate driver 32 on the right-hand side of Figure 5 and from there to the data link layer module. In the other state LINK, the logic signals 1 and 0 are output on the lines EN and \overline{EN} . This changes over the signal flow. As a result, the data link layer module 10 operates as transmitter. The data pass through the first tristate driver 32 on the left-hand side of Figure 5, the optocoupler in the optocoupler unit 31, the first

tristate driver 32 on the right-hand side of Figure 5 and pass from there to the input of the physical layer module 20.

5 The above-described embodiments of an electrical insulation device can be advantageously used not just for the IEEE 1394 bus standard. They can be employed wherever bidirectional connecting lines are intended to be provided with electrical insulation. This problem can also arise in other bus systems.

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New Claims

1. Electrical insulation device for a bidirectional
connecting line (CTL[0:1], D[0:7]), that connects two
5 electronic circuit units (10, 20) to one another, said
electrical insulation unit (30) being located anywhere
along the connecting line (CTL[0:1], D[0:7]) and
comprises at least one optocoupler providing electrical
insulation, **characterized in that**, either one single
10 optocoupler or two separate optocouplers (311, 312) are
provided for the bidirectional connecting line (CTL[0:1],
D[0:7]), and in that a control unit (33) is provided,
which generates switching signals (EN, \overline{EN}), which
switching signals (EN, \overline{EN}) either change over the
15 effective direction of the single optocoupler with regard
to the associated connecting line (CTL[0:1], D[0:7]), or
which switching signals activate one of the two
optocouplers (311, 312) and deactivate the other
optocoupler, for transmission of signals via the
20 associated connecting line (CTL[0:1], D[0:7]) in a
direction opposite to the previous signal flow direction.

2. Electrical insulation device according to Claim
1, the bidirectional connecting line (CTL[0:1], D[0:7])
25 relating either to a data line (D[0:7]) or a control line
(CTL[0:1]).

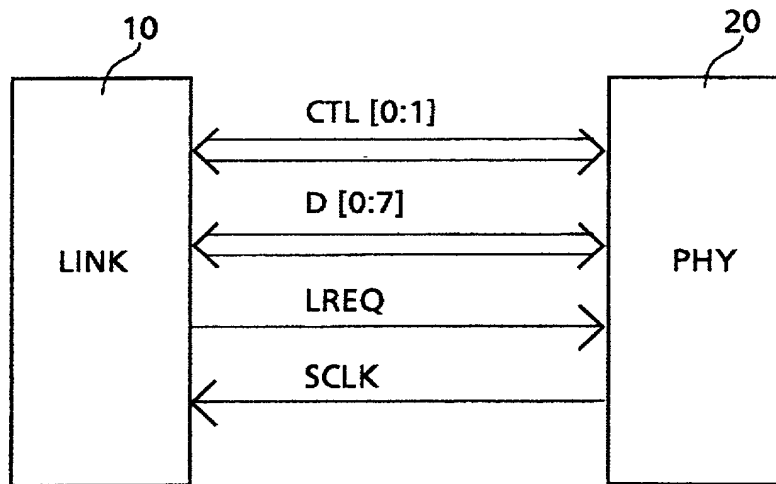
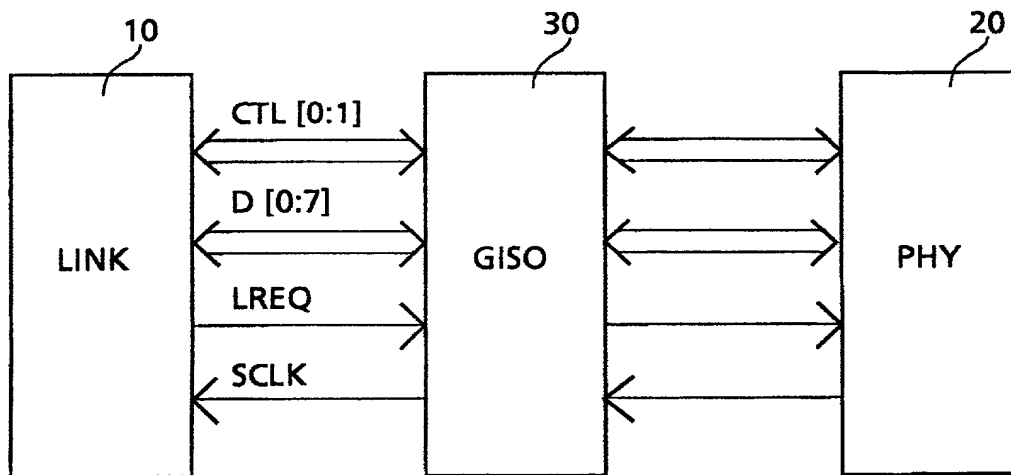
3. Electrical insulation device according to claim 1
or 2, the circuit units (10, 20) which are connected to
30 one another via the connecting line relating to the
circuit blocks, data link layer block (10) and physical
layer block (20) of a connection interface, in particular
IEEE 1394 bus interface.

35 4. Electrical insulation device according to Claim
3, the respective control unit (33) evaluating the
control signals on two control lines (CTL[0:1]) of the
connecting bus between data link layer block (10) and

physical layer block (20) in accordance with the IEEE 1394 Standard.

5. Electrical insulation device according to one of Claims 1 to 4, tristate drivers (32), which are switched into corresponding states by the control unit (33), being used for changing over between the optocouplers or for changing over the effective direction of one optocoupler.

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**Fig.1****Fig.2**

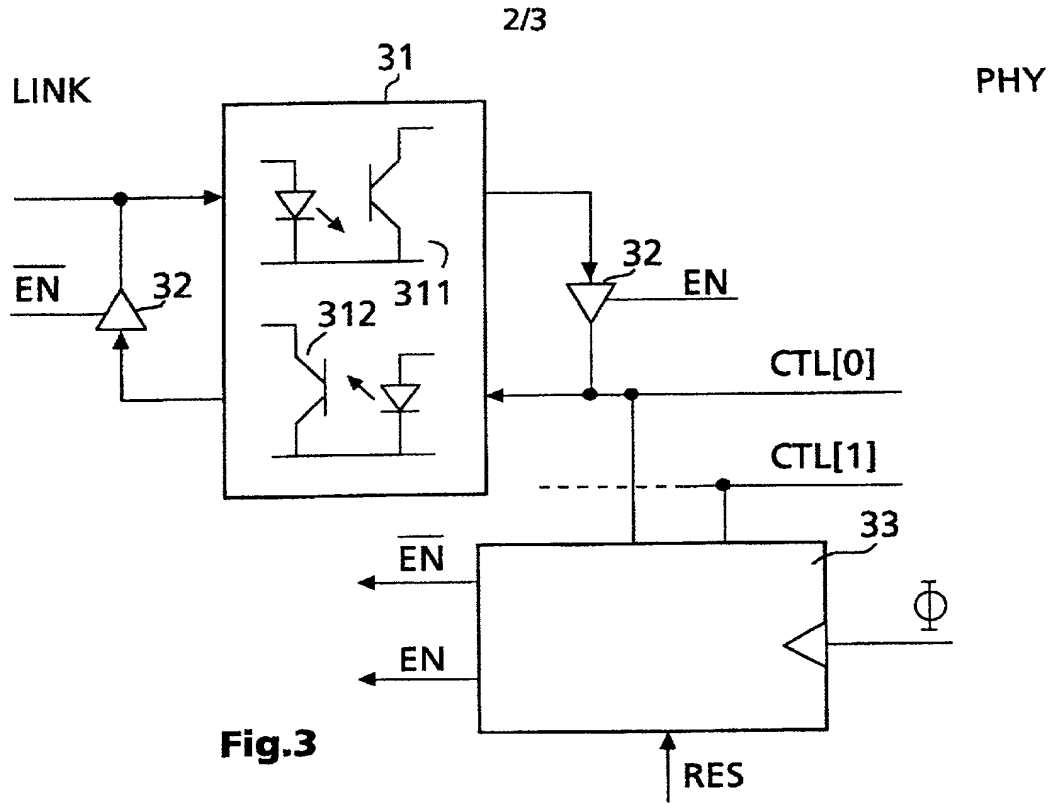


Fig.3

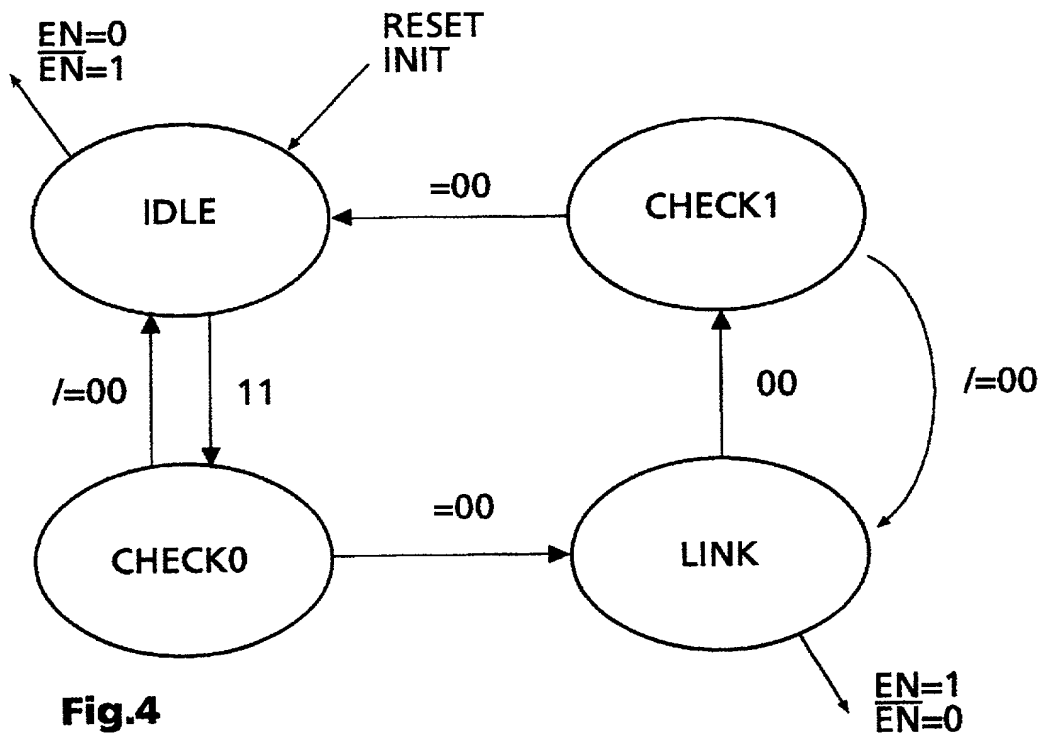
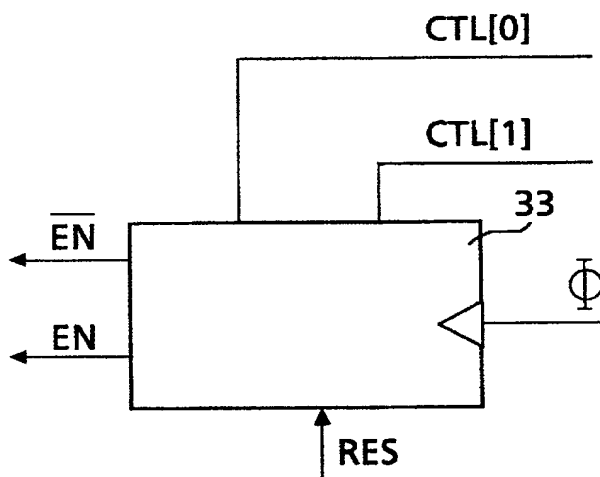
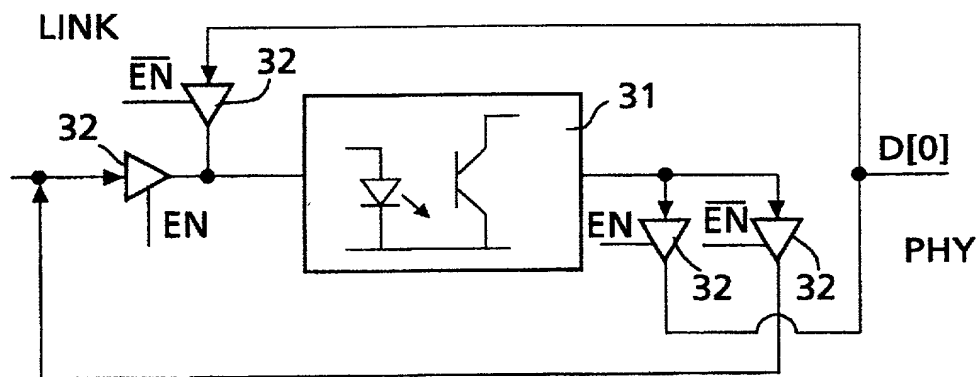


Fig.4

**Fig.5**

DECLARATION FOR UNITED STATES PATENT APPLICATION,
POWER OF ATTORNEY, DESIGNATION OF CORRESPONDENCE ADDRESS

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name, and that I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**ELECTRICAL INSULATION DEVICE WITH OPTOCOUPLER FOR BIDIRECTIONAL
CONNECTING LINES**

the specification of which

(CHECK ONE) () is attached hereto.

(xx) was filed on July 07, 2000, Application Serial. No. PCT/EP 00/06476
and was amended on .

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with 37 CFR 1.56(a).

I hereby claim foreign priority benefits under 35 USC 119 of any foreign application(s) for patent, utility model, design or inventor's certificate having a filing date before that of the application(s) on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
Number	Country	Date Filed	Yes	No
199 33 135.9	DE	July 19, 1999	xx	

I hereby claim the benefit under 35 USC 120 of any US Application(s) listed below, and, insofar as the subject matter of each of the claims of this Application is not disclosed in the prior US application in the manner provided by the first paragraph of 35 USC 112, I acknowledge the duty to disclose information which is material to the examination of this application in accordance with 37 CFR 1.56(a).

Serial No.: _____ Filed: _____

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both, under of 18 USC 1001 and that such wilful false statements may jeopardize the validity of the application or any patent issued thereon.

I hereby appoint the following attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: Joseph S. Tripoli (Reg. No. 26,040)
Telephone: (609) 734-9443.

Address all correspondence to Joseph S. Tripoli, Patent Operations - Thomson multimedia Licensing, Inc. - CN 5312 - Princeton, New Jersey 08543-0028.

Signature: Klaus Gaedke Date: 23 day of November, 2001.

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Signature: Herbert Schütze Date: 23 day of November, 2001.

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